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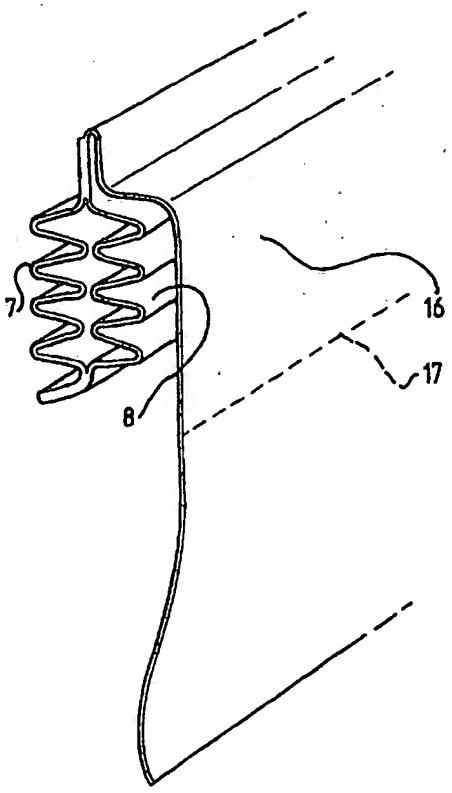
(57) Abstract

An air-bag (3) is defined by two pairs of fabric (7, 8) connected by a peripheral seam (2, 6), the seam surrounding an area (3) which defines the air-bag. At least one fabric flap (10, 11) extends away from the seam over part of the length of the seam. The flap or flaps surround the air-bag when it is in the folded state and together define a line of mechanical weakness (12) which is adapted to split when the air-bag is inflated.



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AN AIR-BAG AND A METHOD OF FABRICATING AN AIR-BAG

THE PRESENT INVENTION relates to an air-bag and more particularly relates to an air-bag for use in a motor vehicle.

It has been proposed to provide an air-bag within a motor vehicle, the air-bag being adapted to be inflated in the event that an accident should occur in order to provide protection for the driver of the vehicle or a passenger within the vehicle.

Such air-bags are made of a fabric. A typical air-bag is stored, in an initial folded state, within a housing. The housing serves to protect the air-bag, while it is being transported subsequent to manufacture, while it is being fitted in position on a motor vehicle, while it is being stored in the fitted position and also during the initial stages of inflation of the air-bag.

It is important that the air-bag is protected so that it is not damaged or cut, for example, on the sharp edge of a piece of metal.

It has been proposed that air-bags should be mounted in various positions within a motor vehicle, and in particular it has been proposed that certain air-bags should be stored within a rec ss located in part of the body of a vehicle that defines the door opening. In such a position there is only a very small amount of space

available, making it difficult to design an appropriate housing to store the air-bag. There also maybe sharp metal edges present in such a location. The present invention seeks to provide an improved air-bag which may be especially suitable for use when the air-bag has to be mounted within a small recess formed in the body of the vehicle or, a small recess formed in a seat present within the vehicle, although it is to be appreciated that air-bags in accordance with the invention may find other applications.

According to this invention there is provided an air-bag, the air-bag being defined by two layers of fabric inter-connected by a peripheral seam, the seam surrounding an area which defines the air-bag, there being at least one fabric flap which extends away from the seam, over part of the length of the seam, the flap or flaps surrounding the air-bag when in the folded state and defining a line of mechanical weakness which is adapted to split when the air-bag is inflated.

Preferably the flap or flaps are formed integrally of the same fabric forming the air-bag.

Conveniently the air-bag is formed from a double web of fabric, comprising an upper layer and a lower layer, the threads forming the upper layer being woven together with the threads forming the lower layer in a predetermined region which defines said seam.

In one embodiment two claps are provided, the two flaps together embracing the folded air-bag so that free edges of the flaps abut each other to form a seam, the free edges being secured together to form the said line of mechanical weakness. The free edges may be secured

together by ultra-sonic welding, by glue, by sewing, or by co-operating elements of hook-and-loop material.

Alternatively, a single flap is provided, the single flap totally surround the folded air-bag, the single flap being provided with a line of mechanical weakness defined by a cut-line. Preferably the cut-line comprises a cut-line formed by a laser.

Conveniently adjacent the periphery of the air-bag the fabric defines a tube. The tube defined by part of the fabric may communicate with the interior of the air-bag. The air-bag may be inflated by a flow of gas passing along the tube.

An elongate element of rigid material may be inserted into the tube. Parts of the tube may be cut away to expose the elongate element. The elongate element may, in either event, be useful in mounting the air-bag in position.

The elongate element may comprise a rigid rod, but alternatively the elongate element may comprise a rigid tube, and there may be apertures in the side wall of the rigid tube. If a rigid tube with apertures of this type is used, the gas that is used to inflate the air-bag may flow through the rigid tube, through the apertures in the side walls of the rigid tube and thus, through the communication between the tube defined by the fabric and the interior of the air-bag in order to inflate the air-bag.

Advantageously part of the said seam defining the periphery of the air-bag is relatively broad, the said flap or flaps being positioned to lie adjacent the said broad band when the air-bag is in the folded condition, holes

being provided extending through the portions of the flap or flaps lying adjacent the said broad band and through the broad band to facilitate mounting of the air-bag in position.

In an alternative embodiment of the invention at least one portion of one of said flaps is separated from the rest of the flap in the region of the seam to form a mounting tab.

The invention also relates to a method of fabricating an air-bag, the method comprising the steps of fabricating an air-bag comprising two adjacent layers of fabric inter-connected in a predetermined region which surround an area that will form the operative part of the air-bag, there being a flap or flaps extending from one side of said region, folding the said area that is to form the air-bag to have a compact state, folding the flap or flaps around the folded air-bag and securing the flap or flaps in position, including the step of providing the flap or flaps with a line of mechanical weakness.

The method may comprise the step of providing a plurality of holes in part of the said seam to facilitate mounting of the air-bag in position.

In one method two flaps are present, the step of providing the line of mechanical weakness comprising the step of forming a seam connecting abutting portions of the two flaps. In an alternative method there is one flap and the step of providing the line of mechanical weakness comprises providing a cut-line in said flap. The cut-line may be produced using a laser.

In order that the invention may be more readily understood, and so that further features thereof may be appreciated, the invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a plan view of a web of fabric from which an air-bag is made,

FIGURE 2 is a sectional perspective view of a bag cut from the fabric of Figure 1, with the various components of the bag being separated to facilitate an understanding of the drawing,

FIGURE 3 is a view corresponding to Figure 2 showing the bag in a partly folded state,

FIGURE 4 is a further perspective view corresponding to Figures 2 and 3, showing the bag in the fully folding state and showing a rail on which the bag may be mounted,

FIGURE 5 is a view corresponding to Figure 3 illustrating an alternative form of bag,

FIGURE 6 is a view showing the bag of Figure 5 in a subsequent stage during its manufacture,

FIGURE 7 is a view showing the bag of Figures 5 and 6 in the final stage of its manufacture, also illustrating a rail on which the bag may be mounted,

FIGURE 8 is a view corresponding to Figure 2 illustrating a modified embodiment of the invention,

FIGURE 9 is a further view illustrating the embodiment of Figure 8 in a completed condition,

FIGURE 10 is a view corresponding to Figure 9, but showing a modified embodiment of the invention,

FIGURE 11 is another corresponding view illustrating a further embodiment of the invention, and

FIGURE 12 is another view illustrating another embodiment of the invention.

It has been proposed previously to fabricate an air-bag from a double web of fabric, comprising an upper layer of fabric and a lower layer of fabric, by weaving together, in pre-selected areas, the threads forming the upper layer of fabric with the threads forming the lower layer of fabric so that, in the predetermined areas, a single integral layer of fabric is formed. Effectively, the upper layer and the lower layer are thus joined together in the predetermined areas without any additional stitching or bonding techniques being used. This procedure is described in more detail in WO90/09295. In the described embodiment of the invention, this technique is utilised.

Referring initially to Figure 1 of the accompanying drawings, in an initial stage during the manufacture of an air-bag in accordance with the invention, a double web of fabric 1 is created and in a predetermined region 2, the threads forming the upper layer of fabric are woven together with the threads forming a lower layer of fabric, so that in the region 2 there is effectively a single integral layer of fabric.

In the illustrated embodiment the region 2 substantially surrounds an elongate area 3, that area 3 being destined to form the operative part of an air-bag.

The area 3 is of generally elongate form, and along the lower sides of the area 3, as illustrated, the region 2 is relatively narrow. However, along the upper side of the area 3, in the orientation illustrated, the region 2 is relatively broad, thus defining a relatively broad band 4 where the upper layer of fabric is effectively formed integrally with the lower layer of fabric.

Subsequently, the part of the web bounded by the region 2 is cut away from the web, the cut being effected along the dotted line 5. It is to be appreciated that the dotted line 5 extends immediately adjacent the outer edge of the region 2 along the lower sides of the area 3, but is spaced away from the edge of the broad band 4 of the region 2 which extends along the upper edge of the area 3 in the orientation shown in Figure 1.

Figure 2 is a sectional view taken through the component cut from the web 1.

Referring to Figure 2 the broad band 4 of the region 2 is illustrated, and it can be seen that in the region of the broad band 4 there is effectively only a single layer of fabric 6. Beneath the region 4, two layers of fabric 7,8 are visible which effectively form the area 3, and beneath the area 3, the region 2 where again there is only a single layer of fabric 9 can be seen.

The portion of the original web that was between the broad band 4 and the cut-line 5, now forms two separate flaps 10 and 11.

It is to be appreciated that the two layers of fabric 7 and 8 forming the area 3 would actually be located in contact with each other, since there would be no air space left between these layers of fabric, but have been shown separated in Figure 2 simply to facilitate an understanding of the arrangement.

Referring now to Figure 3, during a subsequent step in the manufacture of the air-bag, the fabric layers 7 and 8 in the area 3 are folded with a concertina-like fold, so that the fabric 7 and 8 forming the area 3 occupies a minimum amount of space.

Subsequently the flaps 10 and 11 are folded downwardly. A part of each flap thus lies adjacent the broad band 4, and further parts of the flap surround the folded fabric layers 7 and 8. The free edges of the flaps 10 and 11 abut each other beneath the folded fabric layers 7 and 8 to form a seam 12. The seam 12 may be secured by stitching, by ultra-sonic welding, by glue or adhesive, or even by providing, on the flaps 10 and 11, co-operating elements of hook-and-loop inter-engageable material such as that sold under the Registered Trade Mark **VELCRO**.

In any event, it can be seen that the two flaps 10 and 11 have been folded downwardly to lie on either side of the broad band 4 and to surround the folded layers of fabric 7 and 8 that will form the air-bag, and are subsequently joined together at the seam 12.

A plurality of holes 13 may then be punched, or otherwise formed through the broad band 4 and the adjacent regions of the flaps 10 and 11. The apertures pass effectively through three thicknesses of fabric, namely the

thickness of fabric forming each of the two flaps 10 and 11 and the relatively thick layer of fabric that forms the broad band 4.

It is to be appreciated that the fabricated element shown in Figure 4 may be mounted in position on a rail 14 provided with a plurality of projecting hooks or pegs 15, simply by inserting the hooks or pegs 15 through the holes 13.

The air-bag defined by the area 3 of the initial web 1 as constituted by the layers of fabric 7 and 8, would be connected to a gas generator. The gas generator would be activated in response to a sensor which senses an accident. As the air-bag inflates, the seam 12 splits, permitting the air-bag to become fully inflated.

It is to be appreciated that in the air-bag described above, there is no need to provide a separate housing, since the flaps 10 and 11, which are formed integrally from the same material that forms the air-bag, simply surround the folded air-bag and provide the required degree of protection.

An air-bag as illustrated above may easily be mounted in position in a small space located in part of the body of a motor vehicle defining the door opening, or in a seat. Also, an air-bag manufactured using the general principles described above, may be mounted in position in a steering wheel or in the dashboard of a motor vehicle without the need for providing a separate housing.

Figure 5 illustrates a modified embodiment of the invention. In this embodiment of the invention only one flap 16 is provided located above the broad band 4. This

flap 16 is provided with a laser-cut 17 extending axially along the flap. The laser-cut defines a predetermined line of mechanical weakness. A laser can be used to cut successive short lengths of the fabric along a predetermined line, leaving small, relatively weak "bridges" of fabric which join the areas of fabric on either side of the line.

The single flap 16 may be folded downwardly, as shown in Figure 6, to lie adjacent one side of the folded air-bag constituted by the regions of fabric 7 and 8, and subsequently may be folded round beneath the regions of fabrics 7 and 8 so that the free edge of the flap 16 lies adjacent the broad band 4. The free edge may be secured to the broad band 4 by any appropriate means such as ultra-sonic welding, gluing or even sewing. A plurality of holes 13 may again be provided to enable the air-bag to be mounted on the rail 14 provided with the hooks or pins 15.

It is to be noted that the line 17 of the laser-cut is located in the same effective position as that occupied by the seam 12 in Figure 4. When the air-bag is inflated, the flap 16 will split along the line of the laser-cut. Using a laser-cut line of this type enables a very predictable performance to be achieved. Using seams made of glue, ultra-sonic welding or stitching, as mentioned with reference to the embodiment of Figure 4, may lead to erratic results.

Figure 8 illustrates a further modified embodiment of the invention. In this embodiment of the invention, instead of a broad band 4 being provided between the area 3 and flaps 10 and 11, instead a tube 18 is provided. A rod 19 may be inserted into the tube during the folding process, and the final assembly will have the appearance

illustrated in Figure 9, with a rod, encased within the tube, being present at the top of the bag. The presence of the rod may facilitate the mounting of the bag in position. The rod provides a certain degree of rigidity and will serve to spread any load applied to the mounting points. The rod 19, encased within the tube 18 may be slid into an appropriate channel provided in a motor vehicle in order to mount the air-bag in position. In Figure 9, part of the tube 18 defined by the fabric is cut away, in the region 20, thus exposing an intermediate part of the rod 19. This may facilitate the use of the rod 19 in mounting the air-bag in position, especially if the air-bag is to be mounted in position on a plurality of hooks or the like. The hooks may be slid between the exposed portion of the rod 19, revealed in the cut-away portion 20 of the tube 18 defined by the fabric, and the seam that forms the top part of the air-bag when the air-bag is in the orientation shown in Figure 9.

Figure 10 illustrates a further modified embodiment which incorporates the tube 18 and rod 19 as described above, in combination with the broad band 4 of the embodiment of Figures 1 to 4. The broad band 4 is provided with the holes 13 to enable this embodiment to be mounted on a rail, such as the rail 14. The presence of the rod 19 will provide the bag with rigidity and will serve to assist in absorbing any stresses applied to the broad band 4 by the mounting hooks or pins 15.

Figure 11 illustrates a further embodiment of the invention. In this embodiment the region 2 that forms the seam located at the top of the bag in the orientation illustrated, does not form a broad band as in previous embodiments, but is simply a linear seam. In the arrangement illustrated, part of the flap 11 which is

adjacent the seam 2 is cut away from the rest of the flap, forming a four-sided mounting tab 21, which is shown in a vertical position. An aperture 22 is provided in the mounting tab 21. The mounting tab 21 may be separated from the rest of the fabric forming the flap 11 by means of a laser cut. It is to be appreciated that a plurality of mounting tabs of this type may be provided to mount the bag in position.

Figure 12 illustrates a further embodiment of the invention which is similar to that of Figure 9. In this embodiment a tube 18 is provided immediately adjacent the flaps 10 and 11, the tube communicating, at spaced intervals, by means of internal openings 23 with the interior of the air-bag. In these regions, the seam between the tube and the interior of the bag is broken. It is to be understood, therefore, that any gas flowing along the tube 18 will be directed into the air-bag through the internal openings 23. Consequently, the tube 18 may be used as a supply conduit for gas to inflate the air-bag.

However, in Figure 12, a rigid elongate element 24 is illustrated inserted in the tube 18 formed of the fabric, the elongate element 24 itself being in the form of a tube. A plurality of apertures 25 are formed in the side wall of the tube 24, these apertures being co-aligned with the internal openings 23. Gas to inflate the air-bag may consequently be passed through the interior of the tube 24, subsequently flowing through the apertures 25 and the internal openings 23 to the interior of the gas-bag to provide an inflationary effect.

The rigid tube 24, in such an embodiment, may serve not only to assist in mounting the air-bag in position, but

also acts as a supply conduit for gas to inflate the air-bag.

Whilst the invention has been described with reference to embodiments where upper and lower layers of fabric in a double web have predetermined regions thereof where threads from the upper and lower layers of fabric are inter-woven effectively to form a single integral layer, it is to be appreciated that the present invention is equally applicable to arrangements in which two separate layers of fabric are utilised which are secured together by stitching, ultra-sonic welding or any other bonding technique. Also, whilst in the described embodiment of the invention the flap or flaps which surround the folded air-bag are formed integrally of the same fabric that constitutes the air-bag, in modified embodiments of the invention, the fabric forming the flap or flaps may be of a separate material which may be secured to the material forming the air-bag by stitching or some other bonding technique.

The flap or flaps which surround the folded air-bag of the invention may well be sufficient to protect the air-bag while it is being transported subsequent to manufacture, while it is being fitted in position in a motor vehicle, while it is being stored in the fitted position and also during the initial stages of inflation of the air-bag. Consequently, by using an embodiment of the invention, it may be possible to obviate the necessity to provide a separate housing for the air-bag.

CLAIMS:

1. An air-bag, the air-bag being defined by two layers of fabric inter-connected by a peripheral seam, the seam surrounding an area which defines the air-bag, there being at least one fabric flap which extends away from the seam, over part of the length of the seam, the flap or flaps surrounding the air-bag when in the folded state and defining a line of mechanical weakness which is adapted to split when the air-bag is inflated.

2. An air-bag according to Claim 1 wherein the flap or flaps are formed integrally of the same fabric forming the air-bag.

3. An air-bag according to Claim 1 or 2 wherein the air-bag is formed from a double web of fabric, comprising an upper layer and a lower layer, the threads forming the upper layer being woven together with the threads forming the lower layer in a predetermined region which defines said seam.

4. An air-bag according to any one of the preceding Claims wherein two flaps are provided, the two flaps together embracing the folded air-bag so that free edges of the flaps abut each other to form a seam, the free edges being secured together to form the said line of mechanical weakness.

5. An air-bag according to Claim 4 wherein the said free edges are secured together by ultra-sonic welding.

6. An air-bag according to Claim 4 wherein the said free edges are secured together by glue.

7. An air-bag according to Claim 4 wherein the said free edges are secured together by sewing.

8. An air-bag according to Claim 4 wherein the free edges are secured together by co-operating elements of hook-and-loop material.

9. An air-bag according to any one of Claims 1 to 3 wherein a single flap is provided, the single flap totally surrounding the folded air-bag, the single flap being provided with a line of mechanical weakness defined by a cut-line.

10. An air-bag according to Claim 9 wherein the cut-line comprises a cut-line formed by a laser.

11. An air-bag according to any one of the preceding Claims wherein adjacent the periphery of the air-bag the fabric defines a tube.

12. An air-bag according to Claim 11 wherein the tube defined by part of the fabric communicates with the interior of the air-bag.

13. An air-bag according to Claim 11 or 12 wherein an elongate element of rigid material is inserted into said tube.

14. An air-bag according to Claim 13 wherein the said elongate element comprises a rigid rod.

15. An air-bag according to Claim 13 wherein the elongate element comprises a rigid tube.

16. An air-bag according to Claim 15 wherein there are apertures in the side wall of the rigid tube.

17. An air-bag according to any one of the preceding Claims wherein part of the said seam defining the periphery of the air-bag is relatively broad, the said flap or flaps being positioned to lie adjacent the said broad band when the air-bag is in the folded condition, holes being provided extending through the portions of the flap or flaps lying adjacent the said broad band and through the broad band to facilitate mounting of the air-bag in position.

18. An air-bag according to any one of Claims 1 to 10 wherein at least one portion of one of said flaps is separated from the rest of the flap in the region of the seam to form a mounting tab.

19. A method of fabricating an air-bag, the method comprising the steps of fabricating an air-bag comprising two adjacent layers of fabric inter-connected in a predetermined region which surround an area that will form the operative part of the air-bag, there being a flap or flaps extending from one side of said region, folding the said area that is to form the air-bag to have a compact state, folding the flap or flaps around the folded air-bag and securing the flap or flaps in position, including the step of providing the flap or flaps with a line of mechanical weakness.

20. A method according to Claim 19 comprising the additional step of providing a rod of rigid material which extends along one side of the folded bag.

21. A method according to Claim 19 comprising the additional step of providing a tube of rigid material which extends along one side of the folded bag.

22. A method according to Claims 19, 20 or 21 comprising the step of providing a plurality of apertures in part of the said seam to facilitate mounting of the air-bag in position.

23. A method according to any one of Claims 19 to 22 wherein two flaps are present, the step of providing the line of mechanical weakness comprising the step of forming a seam connecting abutting portions of the two flaps.

24. A method according to any one of Claims 19 to 23 wherein there is one flap and the step of providing the line of mechanical weakness comprises providing a cut-line in said flap.

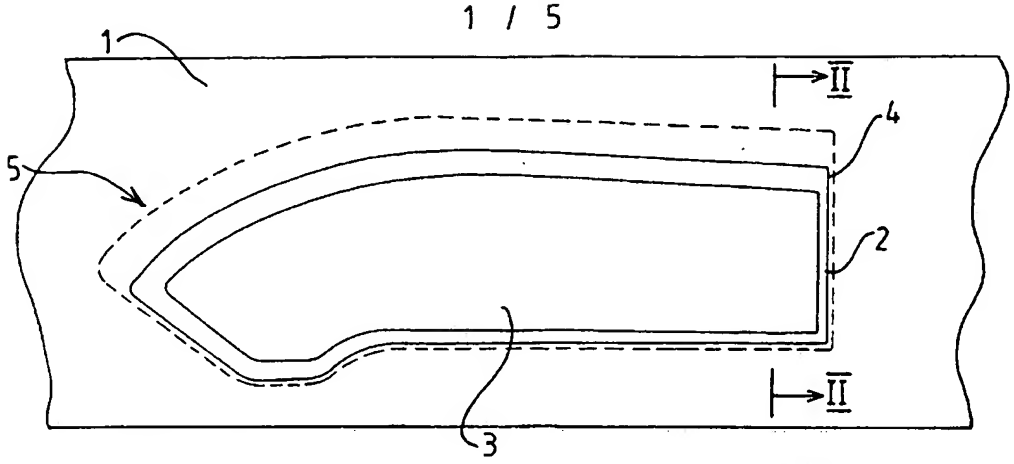


FIG 1

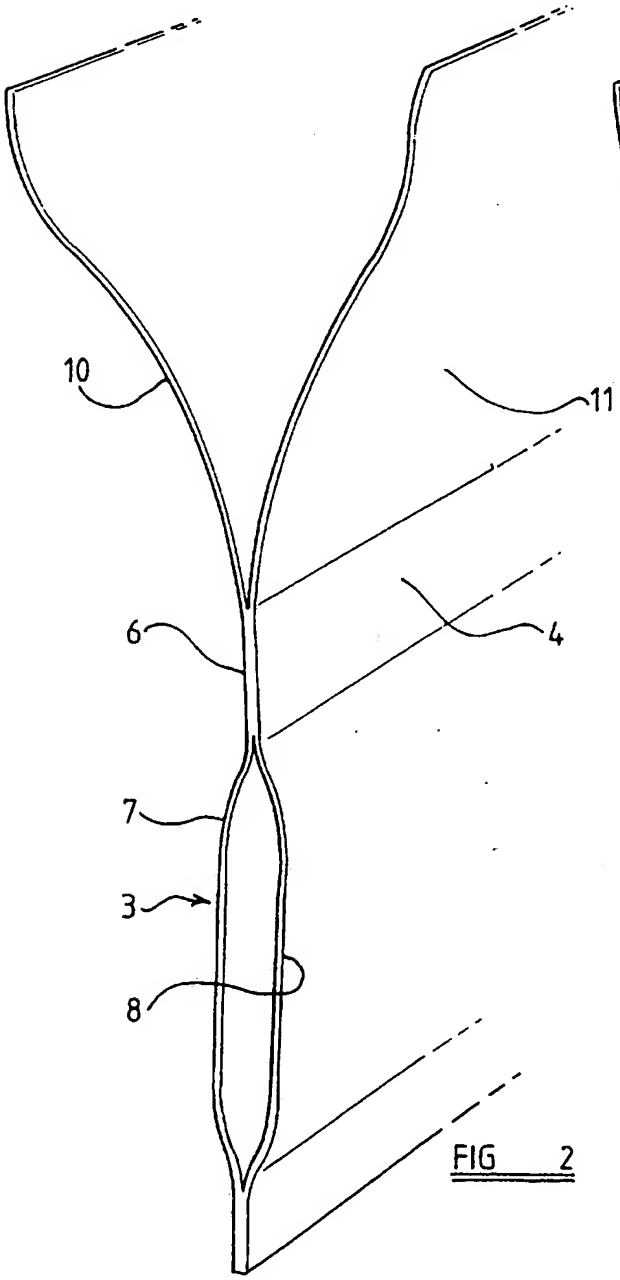


FIG 2

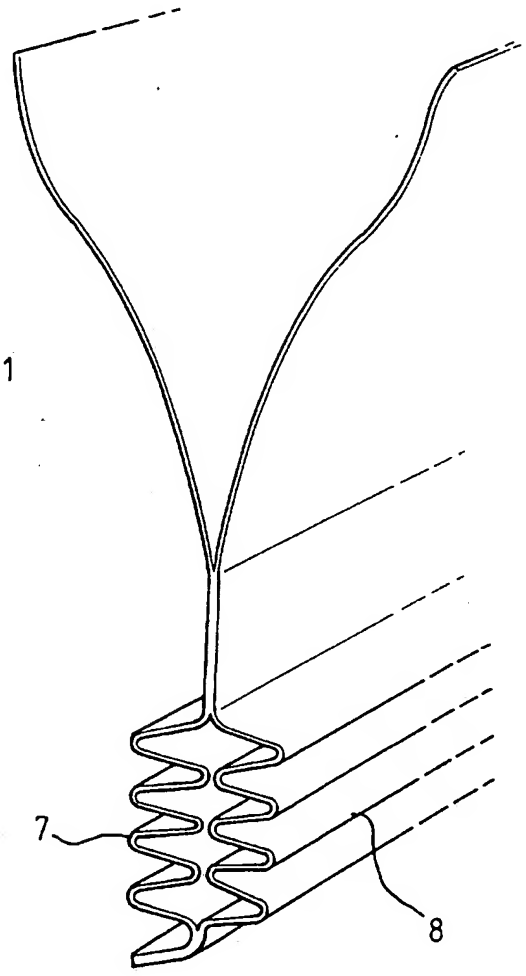


FIG 3

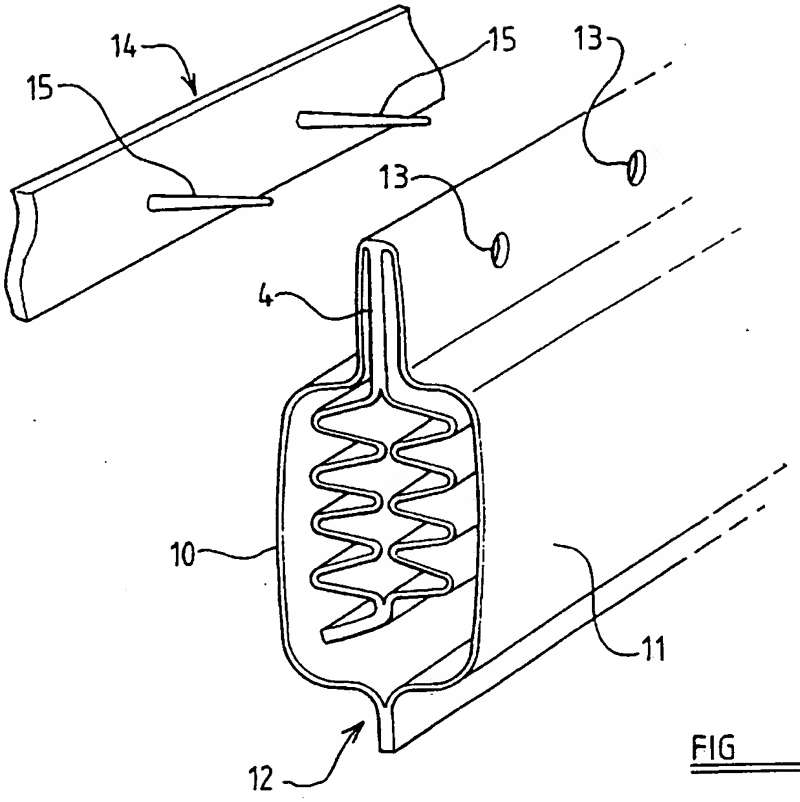


FIG 4

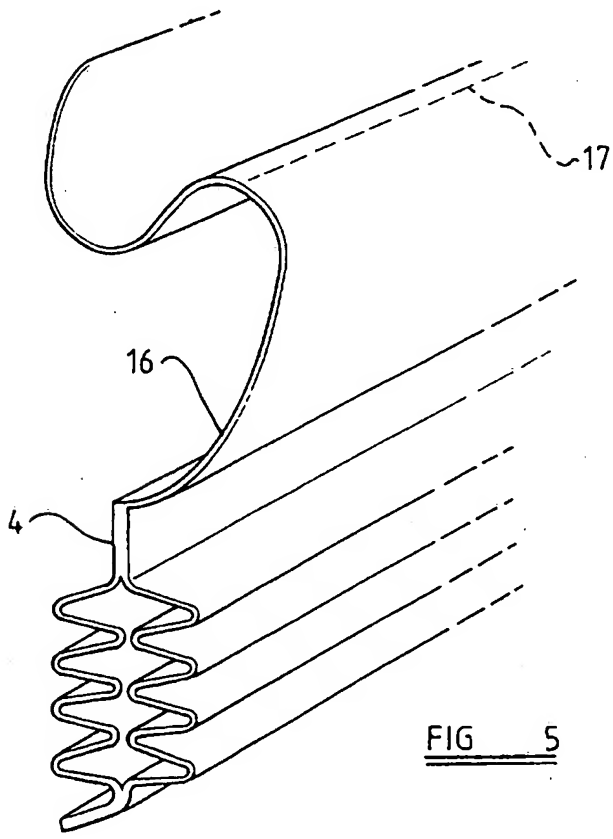
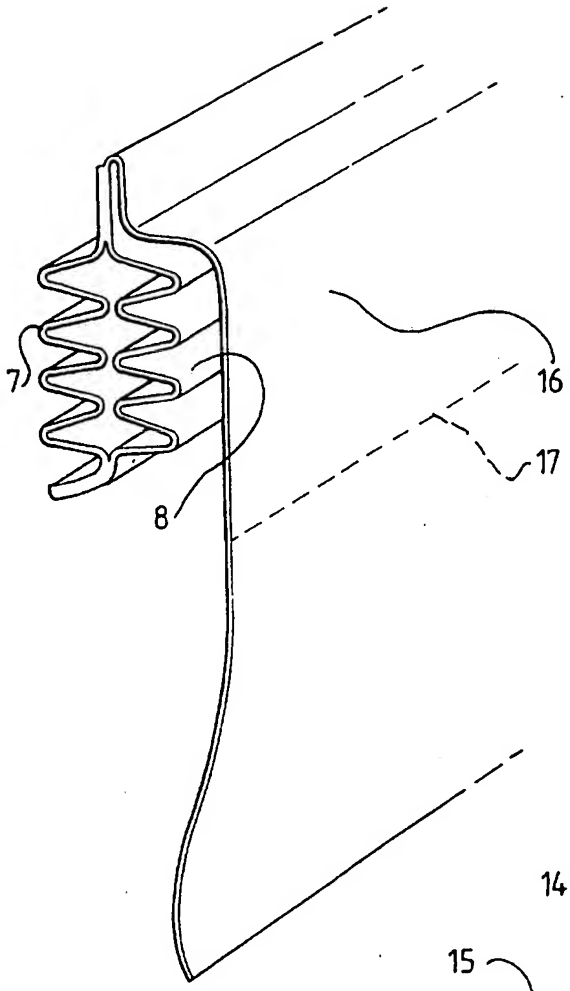


FIG 5

FIG 6



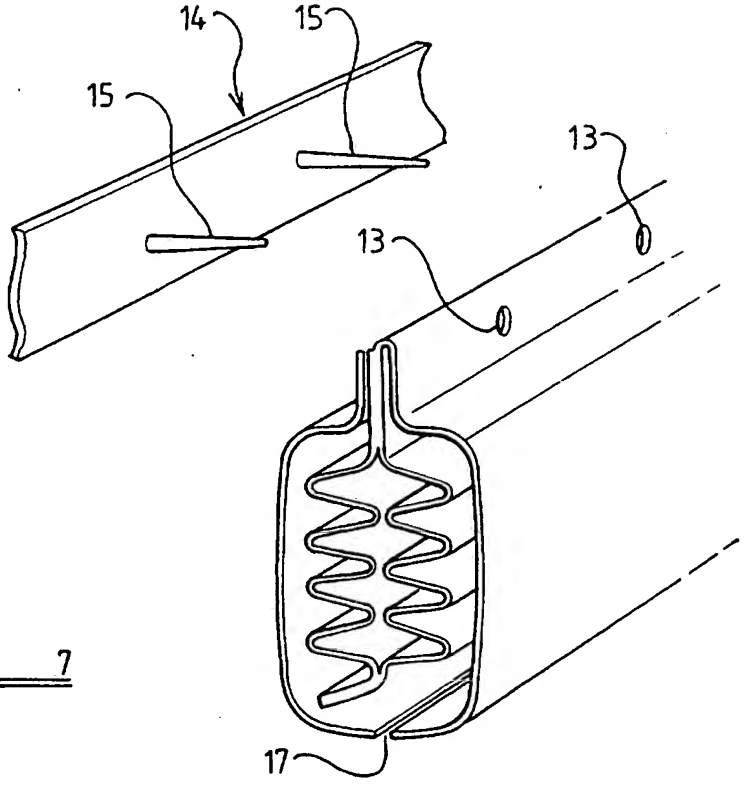


FIG 7

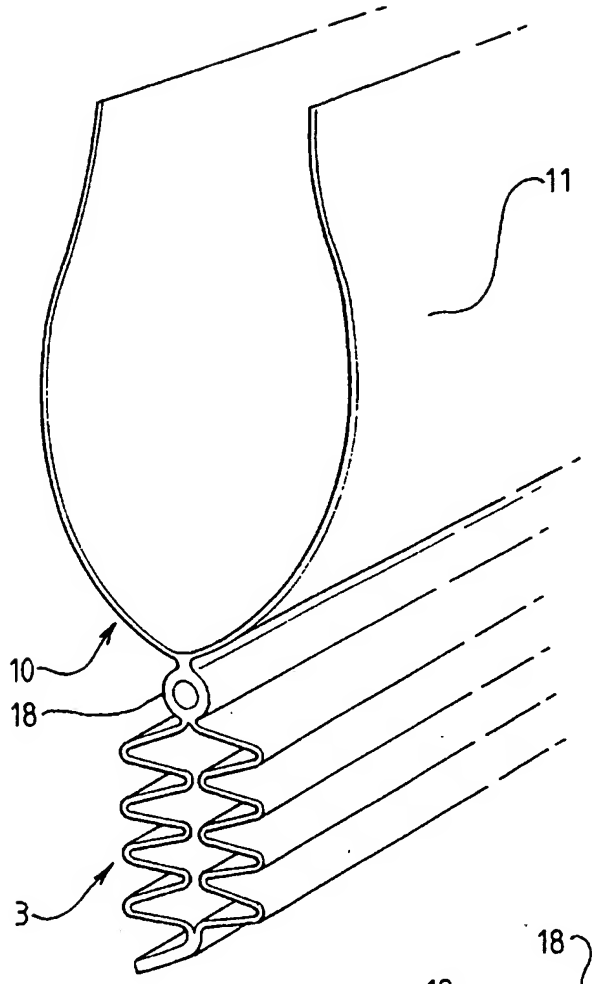


FIG 8

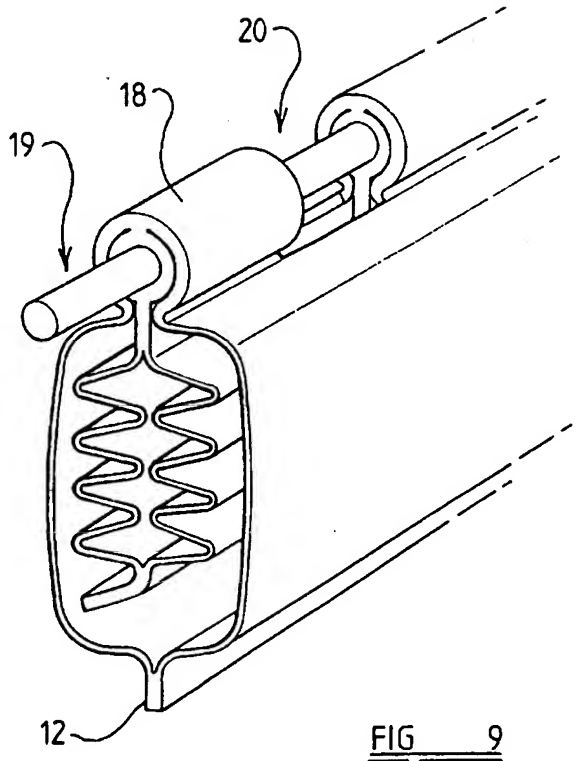


FIG 9

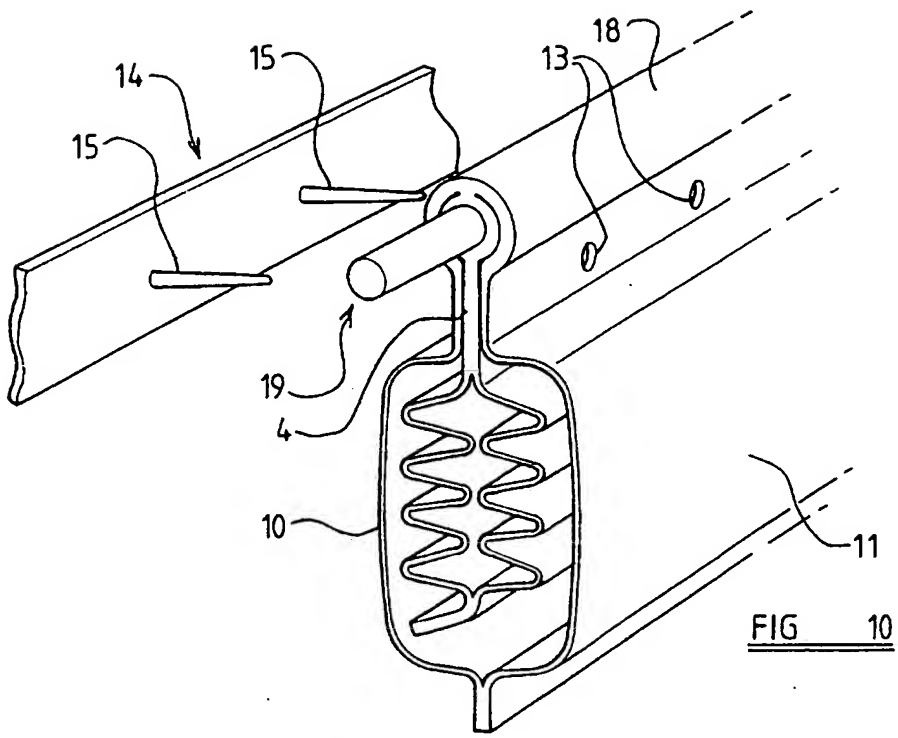


FIG 10

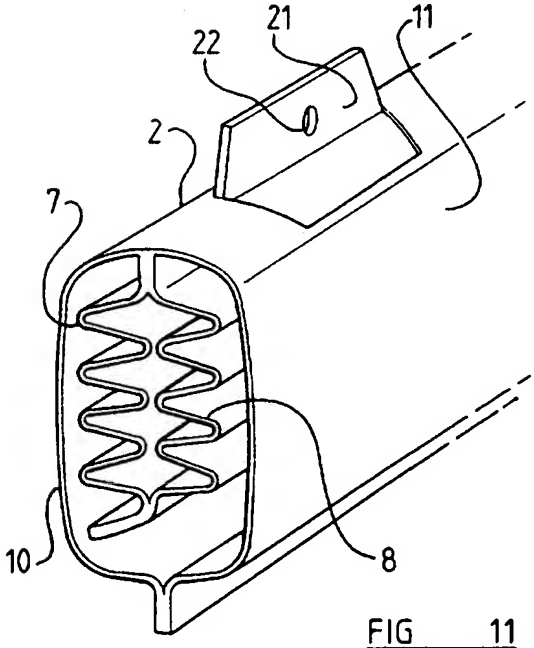


FIG 11

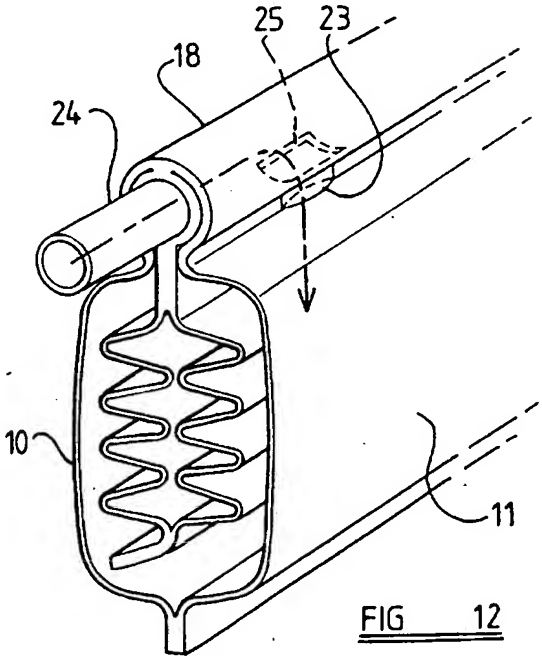


FIG 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/00169

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B60R 21/20, B60R 21/24
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B60R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9009295 A2 (AIRBAGS INTERNATIONAL LIMITED), 23 August 1990 (23.08.90) --	1,15
A	DE 4137691 A1 (MERCEDES-BENZ AKTIENGESELLSCHAFT), 12 November 1992 (12.11.92) --	1,9,19,24
A	US 5221108 A (HIROKAZU HIRABAYASHI), 22 June 1993 (22.06.93) --	1,9,19,24
A	US 5344182 A (LAURITZEN ET AL), 6 Sept 1994 (06.09.94) --	11,13-15,20, 21

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
20 May 1997	25 -05- 1997
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Hans Nordström Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

Information on patent family members

02/04/97

International application No.
PCT/SE 97/00169

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